Claims

1.   A computer-implemented method for locating regions of a target image that match a template image with respect to color characterization, wherein the target image and the template image each comprise a plurality of pixels, the method comprising:

performing a color characterization analysis of the template image; and

searching for regions of the target image having a color characterization that matches, at least to a degree, the color characterization of the template image;

wherein said searching for regions of the target image comprises performing a color characterization analysis for a plurality of regions within the target image;

wherein the color characterization analysis performed for the template image and the color characterization analyses performed for each of the plurality of regions of the target image comprise:

examining color information of at least a subset of pixels;

assigning each examined pixel to a color category that corresponds to a portion of a color space;

determining information indicative of the allocation of the examined pixels across color categories;

wherein, for each of the plurality of regions of the target image, said searching comprises comparing the information obtained in the color characterization analysis of the region to the information obtained in the color characterization analysis of the template image in order to determine whether the region has a color characterization that matches, at least to a degree, the color characterization of the template image.

2.   The method of claim 1,

wherein said searching for regions of the target image comprises:

performing a color characterization analysis for a plurality of regions within the target image to generate color characterization information for each of the target image regions; and

comparing the color characterization information of the template image with

5   the color characterization information for each of the target image regions;

determining zero or more target image regions having a color characterization that matches, at least to a degree, the color characterization of the template image.

10   3.   The method of claim 2,

wherein the color characterization analysis performed for the template image and the color characterization analyses performed for each of the plurality of regions of the target image comprise:

examining color information of at least a subset of pixels;

15   assigning each examined pixel to a color category that corresponds to a portion of a color space;

determining information indicative of the allocation of the examined pixels across color categories;

wherein, for each of the plurality of regions of the target image, the information

20   obtained in the color characterization analysis of the region is compared to the information obtained in the color characterization analysis of the template image in order to determine whether the region has a color characterization that matches, at least to a degree, the color characterization of the template image.

25   4. 2.   The method of claim 1, further comprising:

generating information specifying a location for each region of the target image that is determined to have a color characterization matching the color characterization of the template image.

3. The method of claim 1, further comprising:

for each region of the target image that is determined to have a color characterization matching the color characterization of the template image, displaying information on a graphical user interface indicating a location of the region within the target image.

4. The method of claim 3, further comprising:

for each region of the target image that is determined to have a color characterization matching the color characterization of the template image, displaying information on a graphical user interface indicating a degree to which color information of the region matches color information of the template image.

5. The method of claim 1, further comprising:

receiving the target image;

wherein the target image is received from one of the group consisting of:

a memory medium, a hardware device, and a software application.

6. The method of claim 1,

wherein the template image and the target image comprise hue, saturation, and intensity (HSI) color information;

wherein said examining color information of at least a subset of pixels comprises examining HSI information of the at least a subset of pixels;

wherein said assigning each examined pixel to a color category that corresponds to a portion of a color space comprises assigning each examined pixel to a color category that corresponds to a portion of HSI color space.

7. The method of claim 1, further comprising:

receiving user input specifying a desired color sensitivity level to use in locating target image regions that match the template image;

wherein the user input determines a number of categories into which the color space is divided.

8. The method of claim 1,

wherein said comparing information obtained in the color characterization analysis of each region of the target image to information obtained in the color characterization analysis of the template image comprises:

for each color category of the color space, comparing the percentage of template image pixels assigned to the color category to the percentage of target image region pixels assigned to the color category.

9. The method of claim 1,

wherein the color characterization analysis performed for the template image further comprises:

determining one or more dominant color categories, wherein the one or more dominant color categories are assigned a relatively larger proportion of examined pixels, with respect to other color categories of the color space.

10. The method of claim 9,

wherein said comparing information obtained in the color characterization analysis of each region of the target image to information obtained in the color characterization analysis of the template image comprises:

for each dominant color category, comparing the percentage of template image pixels assigned to the dominant color category to the percentage of target image region pixels assigned to that color category.

11. The method of claim 1,

wherein the color characterization analysis performed for each of the plurality of regions of the target image further comprises:

performing a smoothing operation after said assigning each examined pixel to a color category;

wherein the smoothing operation comprises:

for each respective color category of at least a subset of the possible color categories, re-distributing a portion of the pixels assigned to the respective color category to one or more neighboring color categories.

12. The method of claim 1,

wherein said assigning each examined pixel to a color category is performed in accordance with a fuzzy membership function.

13. The method of claim 6,

wherein said assigning each examined pixel to a color category that corresponds to a portion of HSI color space further comprises:

determining if the respective pixel can be categorized as either black, gray, or white based on one or more of saturation and intensity values of the respective pixel;

assigning the respective pixel to a black, gray, or white category if the respective pixel can be categorized as black, gray, or white, respectively;

determining a color category for the respective pixel based on hue and saturation values of the respective pixel if the respective pixel cannot be categorized as either black, gray, or white.

14. The method of claim 1, further comprising:

receiving user input specifying search criteria to use in locating target image regions that match the template image;

wherein the user input determines one or more parameters affecting said searching for regions of the target image.

15. The method of claim 1,

wherein said searching for regions of the target image is performed using multiple search passes according to a coarse-to-fine search heuristic.

16. The method of claim 1,

wherein said searching for regions of the target image comprises:

performing a first-pass search through the target image to find initial match candidate areas;

performing one or more subsequent search passes in which proximal regions of the candidate areas are searched in order to find a best-matching region in the vicinity.

17. The method of claim 1, further comprising:

determining a step size;

wherein said searching for regions of the target image having a color characterization that matches, at least to a degree, the color characterization of the template image comprises determining locations for the plurality of regions within the target image for which the color characterization analysis is performed;

wherein the step size is used in said determining locations for the plurality of regions within the target image.

18. The method of claim 17,

wherein, after determining a first region identified by a window into the target image, the step size is used to slide the window along the target image by a fixed number of pixels in order to determine a second region.

19. The method of claim 1, further comprising:

determining a sub-sampling size;

wherein the sub-sampling size is used to determine the size of the at least a subset of pixels examined for each of the plurality of regions of the target image.

20. A computer-implemented method for locating regions of a target image that match a template image with respect to color characterization, wherein the target image and the template image each comprise color information, the method comprising:

performing a first-pass search through the target image in order to find initial color match candidate areas;

for each candidate area found in the first-pass search, searching regions proximal to the area in order to find a best-matching region in the area.

21. The method of claim 20,

wherein said performing the first-pass search through the target image comprises:

determining a plurality of regions at which to sample the color information of the target image;

for each of the plurality of sample regions, determining a measure of difference between the color information of the region and the color information of the template image;

for each of the plurality of sample regions, designating the region as an initial color match candidate area if the measure of difference between the color information of the region and the color information of the template image is smaller than a threshold value.

22. The method of claim 21, further comprising:

performing a color characterization analysis of the template image;

for each of the plurality of sample regions, performing a color characterization analysis of the sample region;

wherein said determining the measure of difference between the color information of each sample region and the color information of the template image comprises

5   comparing information obtained in the color characterization analysis of the sample region with information obtained in the color characterization analysis of the template image.

23.   The method of claim 22,

wherein the template image and the target image each comprise a plurality of pixels;

10   wherein the color characterization analysis performed for the template image and the color characterization analyses performed for each of the plurality of sample regions comprise:

examining color information of at least a subset of pixels;

assigning each examined pixel to a color category that corresponds to a

15   portion of a color space;

determining information indicative of the allocation of the examined pixels across color categories;

wherein said comparing information obtained in the color characterization analysis of the sample region with information obtained in the color characterization analysis of the

20   template image comprises comparing the allocations of the examined pixels across color categories for the sample region and the template image, respectively.

24.   The method of claim 23,

wherein the color characterization analysis performed for the template image further

25   comprises:

determining one or more dominant color categories, wherein the one or more dominant color categories are assigned a relatively larger proportion of examined pixels, with respect to other color categories of the color space;

wherein said comparing information obtained in the color characterization analysis of the sample region with information obtained in the color characterization analysis of the template image comprises comparing the dominant color categories of the sample region and the template image, respectively.

25. The method of claim 23,

wherein the color characterization analysis performed for the template image comprises examining color information of each pixel in the template image;

wherein the color characterization analyses performed for each of the plurality of sample regions comprise examining color information of only a subset of the pixels in the sample region.

26. The method of claim 23,

wherein the color information of the template image and the color information of the target image comprise hue, saturation, and intensity (HSI) color information;

wherein said examining color information of at least a subset of pixels comprises examining HSI information of the at least a subset of pixels;

wherein said assigning each examined pixel to a color category that corresponds to a portion of a color space comprises assigning each examined pixel to a color category that corresponds to a portion of HSI color space.
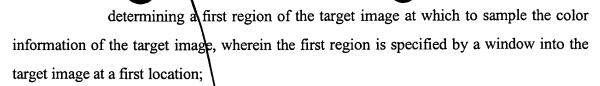
27. The method of claim 21, wherein the target image comprises a plurality of pixels, the method further comprising:

determining a first step size to use in said determining the plurality of regions at which to sample the color information of the target image;

wherein said determining the plurality of regions comprises:

determining a first region of the target image at which to sample the color information of the target image, wherein the first region is specified by a window into the target image at a first location;

determining a second region of the target image at which to sample the color information of the target image, wherein the second region is specified by a window into the target image at a second location which is offset from the first location by a number of pixels specified by the first step size.

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28.   The method of claim 27,

wherein said searching regions proximal to the area in order to find a best-matching region in the area comprises:

determining a second step size which is smaller then the first step size;

using the second step size to determine the regions proximal to the area.

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29.   The method of claim 28,

wherein the second step size is dependent on one or more of:

the first step size;

the size of the initial color match candidate area.

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30.   The method of claim 20,

wherein said searching regions proximal to the candidate area in order to find a best-matching region in the area comprises:

determining a plurality of regions proximal to the candidate area at which to sample the color information of the target image;

for each of the plurality of proximal sample regions, determining a measure of difference between the color information of the region and the color information of the template image;

wherein the best-matching region in the area is a region with a smallest measure of difference.

33
31.   The method of claim 20, further comprising:

5   for each best-matching region found, determining a measure of difference between the color information of the region and the color information of the template image;

generating a final set of regions considered to match the template image with respect to color characterization;

wherein the measure of difference between the color information of each region in
10   the final set and the color information of the template image is less than a threshold value.

34
32.   A computer-implemented method for characterizing color information of an image, wherein the image comprises a plurality of pixels, the method comprising:

for each respective pixel of at least a subset of the pixels, determining a color
15   category for the respective pixel based on hue, saturation, and intensity values of the respective pixel, wherein said determining determines a color category from a plurality of possible color categories;

storing information regarding the percentage of pixels in each of said plurality of possible color categories;

20   storing information regarding one or more dominant color categories, wherein the one or more dominant color categories are assigned a relatively larger proportion of pixels with respect to other color categories;

wherein the stored information characterizes color information of the image.

35
33.   A system for locating regions of a target image that match a template image
25   with respect to color characterization, wherein the target image and the template image each comprise color information, the system comprising:

a processor;

a memory medium coupled to the processor which stores the target image and a color match location program;

wherein the processor is operable to execute the color match location program to:

perform a first-pass search through the target image in order to find initial color match candidate areas;

for each candidate area found in the first-pass search, search regions proximal to the area in order to find a best-matching region in the area.

34. The system of claim 33,

wherein said performing the first-pass search through the target image comprises:

determining a plurality of regions at which to sample the color information of the target image;

for each of the plurality of sample regions, determining a measure of difference between the color information of the region and the color information of the template image;

for each of the plurality of sample regions, designating the region as an initial color match candidate area if the measure of difference between the color information of the region and the color information of the template image is smaller than a threshold value.

35. The system of claim 34, wherein the target image comprises a plurality of pixels, wherein the processor is further operable to execute the color match location program to:

determine a first step size to use in said determining the plurality of regions at which to sample the color information of the target image;

wherein said determining the plurality of regions comprises:

determining a first region of the target image at which to sample the color information of the target image, wherein the first region is specified by a window into the target image at a first location.

determining a second region of the target image at which to sample the color information of the target image, wherein the second region is specified by a window into the target image at a second location which is offset from the first location by a number of pixels specified by the first step size.

35.
36. The system of claim 33,

wherein said searching regions proximal to the candidate area in order to find a best-matching region in the area comprises:

determining a plurality of regions proximal to the candidate area at which to sample the color information of the target image;

for each of the plurality of proximal sample regions, determining a measure of difference between the color information of the region and the color information of the template image;

wherein the best-matching region in the area is a region with a smallest measure of difference.

34.
37. A method for locating regions of a target image that match a template image with respect to color characterization, the method comprising:

automatically determining color features of the template image;

locating one or more regions of the target image that match the color features of the template image.

38.   The method of claim 37, wherein said automatically determining color features of the template image comprises performing a color characterization analysis of the template image.

39.   The method of claim 38, wherein said locating one or more regions of the target image that match the color features of the template image comprises:

        searching for regions of the target image having a color characterization that matches, at least to a degree, the color characterization of the template image;

        wherein said searching for regions of the target image comprises performing a color characterization analysis for a plurality of regions within the target image;

40.   The method of claim 39,

        wherein the color characterization analysis performed for the template image and the color characterization analyses performed for each of the plurality of regions of the target image comprise:

        examining color information of at least a subset of pixels;

        assigning each examined pixel to a color category that corresponds to a portion of a color space;

        determining information indicative of the allocation of the examined pixels across color categories;

        wherein, for each of the plurality of regions of the target image, said searching comprises comparing the information obtained in the color characterization analysis of the region to the information obtained in the color characterization analysis of the template image in order to determine whether the region has a color characterization that matches, at least to a degree, the color characterization of the template image.

41. A method for characterizing the color information of an image, the method comprising:

dividing a color space into a plurality of bins;

for each of at least a subset of pixels of the image:

assigning the pixel to a bin;

applying a fuzzy membership function based on the location of the pixel within the bin to determine a contribution of the pixel to one or more neighboring bins;

distributing the weight of the pixel across the bin and the one or more neighboring bins, in accordance with the contributions determined by the fuzzy membership function;

wherein the distribution of pixels across the bins of the color space characterizes the color information of the image.

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